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MULTICHANNEL PULSE-CODE TELEMECHANICAL UNIT MKT-2,(U)
NOV 76 B A KORNILOV, V Z AHAK, A L BULIS

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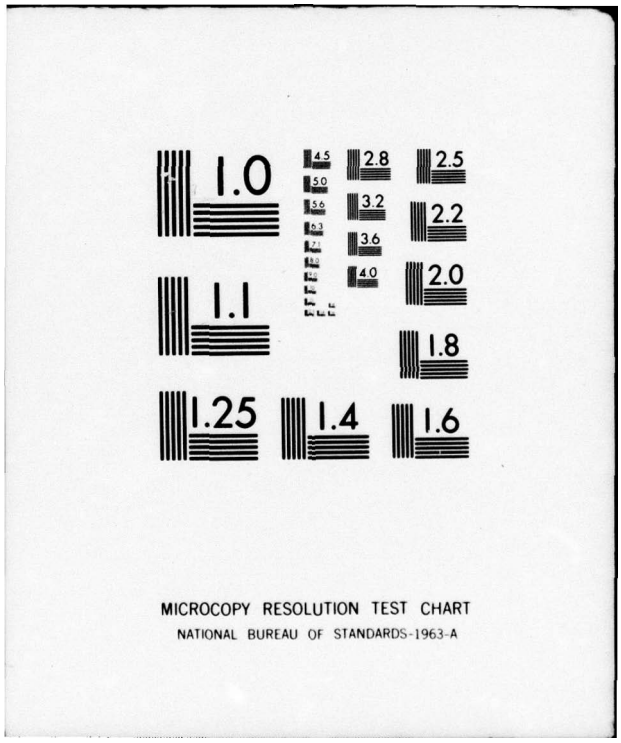
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FOREIGN TECHNOLOGY DIVISION

MULTICHANNEL PULSE-CODE TELEMECHANICAL UNIT MKT-2

by

B. A. Kornilov, V. Z. Ahak,
et al.

EDITED TRANSLATION

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MULTICHANNEL PULSE-CODE TELEMECHANICAL UNIT MKT-2

By: B. A. Kornilov, V. Z. Ahak, et al.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ë in Russian, transliterate as yë or ë. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	A	α		Nu	N	ν	
Beta	B	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	O	ο	
Delta	Δ	δ		Pi	Π	π	
Epsilon	E	ε		Rho	P	ρ	
Zeta	Z	ζ		Sigma	Σ	σ	ς
Eta	H	η		Tau	T	τ	
Theta	Θ	θ		Upsilon	T	υ	
Iota	I	ι		Phi	Φ	φ	
Kappa	K	κ		Chi	X	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	M	μ		Omega	Ω	ω	

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}
rot	curl
lg	log

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MULTICHANNEL PULSE-CODE TELEMECHANICAL UNIT MKT-2

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The telemechanical unit MKT-2 was prepared for assembly-line production by the "Elektropul't" plant, and the basic area of use of the unit is for the automated systems of dispatch control in power engineering and heavy industrial enterprises.

The MKT-2 unit was designed to transmit and receive information about the parameters of industrial processes (TI) [ТИ], about the condition of two-positioned objects (TS) [ТС], and also to transmit and receive remote control commands (TU) [ТУ] and to request additional information (VDI) [ВАИ]. With the presence of existing units of input the MKT-2 can be used to transmit and receive alphanumeric information. It consists of one half-set of a monitoring point (KP) [КП] and one or two half-sets of control points (DP) [АП].

Twelve models are being produced, which are differentiated one from another by capacity and functions. The capacity of the models is shown in table 1.

Model	Capacity (quantity of commands)			
	TI	TS	TU	VDI
A0	10	80	-	-
B0	20	160	-	-
C0	30	240	-	-
A1	10	80	30	10
B1	20	160	30	10
C1	30	240	30	10
A2	10	80	60	10
B2	20	160	60	10
C2	30	240	60	10
A3	10	80	90	10
B3	20	160	90	10
C3	30	240	90	10

Table 1

With the storage of total volume of transmittable information the development of several modifications of each model with different correspondence of the number of units of TI and TS (eight units of TS are equivalent to one unit of TI), was provided.

The MKT-2 is calculated to work off sensors, which transform measurable parameters into direct or rectified current:

a) 5 mA at a resistance of 1000 Ohms; 1 mA at a resistance of 5000 Ohms or -1; 0; +1 mA at a resistance of 2500 Ohms with the ripple factor of the rectified current of no more than 1%;

b) 5 mA at a resistance of 2000 Ohms; 1 mA at a resistance of 6000 Ohms, or -1; 0; +1 mA at a resistance of 3500 Ohms with the ripple factor of no more than 1%.

Telemetrics can be inserted in coded form.

To transmit the telesignal one closed contact of the relay of the position of the monitorable unit is necessary. Also, a non-contact sensor of position, which guarantees signals "1" and "0"in accordance with the magnitudes, which are accepted in the system of elements "Spektr", can be used.

One closed and one open contact of the individual control key are necessary to transmit two-positioned commands of TU. To request additional information two closed contacts of the individual request button are necessary.

Let us examine the operating principles of the MKT-2 assembly.

Information of TI and TS are transmitted without interruption and cyclically. The cycle consists of 11, 21 or 31 sub-cycles (depending on the model of the assembly). One of the cycles is designated to synchronize the distributors of receiving and transmitting half-sets. In this sub-cycle the marker signal is transmitted. The remaining sub-cycles form the information transmitting channels. To transmit indicating information a special correcting code (14, 8) with minimum code spacing, which equals 4, is used. The information part of the code contains eight symbols, which occupy the orders 1, 2, 3, 5, 6, 7, 9 and 11. The remaining six symbols are verifying symbols, the values of which are determined by the method of even-parity check of the individual meanings of the information symbols, which are transmitted in fixed positions in the sub-cycle in agreement with the following equalities:

$$
\begin{gathered}
a_1 \oplus a_2 \oplus a_3 \oplus a_4 = 0; \\
a_5 \oplus a_6 \oplus a_7 \oplus a_9 = 0; \\
a_9 \oplus a_{10} = 0, \\
a_1 \oplus a_2 \oplus a_5 \oplus a_6 \oplus a_9 \oplus a_{11} \oplus a_{12} = 0; \\
a_1 \oplus a_3 \oplus a_5 \oplus a_7 \oplus a_9 \oplus a_{11} \oplus a_{13} = 0; \\
a_{11} \oplus a_{12} \oplus a_{13} \oplus a_{14} = 0.
\end{gathered}
$$

In these equalities a_i represents symbol (0 or 1) of the code in the i-th order. Each equation contains one verifying symbol, which, in this case, is put in dependence on the information

symbols.

The code used in the MKT-2 assembly is formed from the group code (14, 8) by a reversal of all the redundant symbols. This group code has the following generating matrix.

a_1	a_2	a_3	a_4	a_5	a_6	a_7	a_8	a_9	a_{10}	a_{11}	a_{12}	a_{13}	a_{14}
1	0	0	1	0	0	0	0	0	0	0	1	1	0
0	1	0	1	0	0	0	0	0	0	0	1	0	1
0	0	1	1	0	0	0	0	0	0	0	0	1	1
0	0	0	0	1	0	0	1	1	0	0	1	1	0
0	0	0	0	0	1	0	1	0	1	0	1	0	1
0	0	0	0	0	0	1	0	0	0	1	1	1	1
0	0	0	0	0	0	0	0	0	0	0	1	1	1
0	0	0	0	0	0	0	0	0	0	0	0	1	1

The code formed by a similar method relative to the co-set of the group code exposes all possible errors of odd multiplicity, all two-fold errors, and also 95.5% of the errors of fourth multiplicity and 97.6% of the errors of sixth multiplicity, 97% of the errors of eighth multiplicity, 97.6% of the errors of tenth multiplicity, and 92% of the errors of twelfth multiplicity. These data correspond with the data of table 2, where the significances of the coefficient of the undetectable errors of the i-th multiplicity are reduced, which are determined for the codes of several types, which are useable in the multichannel pulse-code units, according to the expression

$$K_i = \frac{N_i \cdot 100}{C_n^i},$$

where N_i is the number of undetected errors of i-th multiplicity; C_n^i is the number of all possible code combinations of length n, which are distant from the working combination for code space i.

The code, accepted in the unit MKT-2, in agreement with table 2 has very high indices of error discovery with a relatively small

number of redundant symbols. This code possesses an important property in relation to the synchronization of the timing oscillators of the transmitting and receiving half-sets; it guarantees a minimum of four fronts of pulses, which enter from the transmitting assembly in the course of one sub-cycle (in the unit MKT-2 the fronts of the pulses arriving from the communication channel are used for synchronization). For the majority of operating code combinations (for example, for 60%) the number of fronts in one sub-cycle, i.e., for 14 oscillations, are 6 or 7. Sufficiently frequent transmission of pulses in the communication channel facilitates conditions of the synchronization of the timing oscillators of the half-sets KP and PU [КП and ПУ].

During the transmission of telemetrics the information symbols of the code are used as the eighth order of the binary code, which assures the coding of 256 discrete levels of remote measurable parameters. During the transmission of the telesignaling on the information symbols eight two-position signals are transmitted.

Management information with telecontrol and request of additional information is transmitted by a code on one set of ten by threes with the use of time mode of pulse. The set TU does not at all depend on the unit TI-TS, and is connected to them only structurally.

The MKT-2 set can operate along standard telegraph channels of apparatus of secondary multiplexing of communications line wires and the lines of power transmission and radio channels. A duplexed channel is necessary for the operation of an MKT-2. For models

A0, B0 and C0 (the remote control unit is excluded) a simplexed channel is used. During the transmission of information of TI and TS an automatic reservation of the communications channel is included.

The duration of the transmission of one command of remote control or request for additional information consists of not more than 1.2 seconds with a transmission rate of the digital information of 40 bauds. The duration of transmission of one report of telemetry or telesignal depends on the model of the set and on the established transmission rate of digital information (table 3).

To control object TU at the output terminal of the KP closed and switching contacts of the receiving relay of remote control are removed. To request additional invormation at the output terminal the closed contasts of the relay of request for additional information are removed by twos.

The receiving analog converter of each telemetric channel was intended for the coupling of analog instruments with nominal current 5 mA and total resistance of up to 2500 Ohms. The basic error of the tele transmission of the channel of telemetry of the set is $\pm$ 1%.

The reproduction of the reports of the telesignals can be accomplished on the dispatcher's board with both mimic and lighted symbols. For the lighted board general receipting of signals of discrepancy is employed.

In the receiving half-set, depending on the type of board, it is possible to install the output subassemblies for the board, either with mimic or with lighted symbols.

Input of information of each sub-cycle (channel) in the computer or into the information processing unit is accomplished with intermediate memory triggers, which store the eight-digit binary code. From the output amplifier to the input of the computer of the data processing unit also the channel number is entered (the address).

After a check of the received information and with the absence of inhibitions from the control junction of the operation of the unit a short-duration signal of the statement of information is produced, and in the course of several oscillations the signal of permission of readout is produced. In this case the singularity of the input of one or another magnitude of TI or group of TS within the limits of one sub-cycle is assured.

In the half-sets of the unit there are junctions of retransmission of information of TI and TS, which are carried out with such calculation, so that individual coupling wires from each object of retransmission are not required. The relay of TI is assured in coded form. Information from the lower half-set DP is put out from the eight common lines of output of information and is entered into the junction of the input in the register of the upper KP. The majority of the logic and functional units of the assembly are fulfilled at the base of the complex "Spektr."

Half-sets KP and PU consist of one or two cabinets. The cabinets are made in the form of individual sections, which are connected by a frame. Each section has two modules, of large and small dimension. The large modules are made up of up to 20 sub-modules or elements with solid assembly, and the small module is made

up of up to 10 sub-modules or elements with solid assembly. The modules of the unit can be moved out and rotated at an angle of up to 100 degrees. The output terminals and connectors are located on the rear wall of the section housing. Maintenance of the cabinets is one-sided. The unit is supplied by the necessary service modules.

Table 2.

1 Устройство телемеханики	2 Применяемый код	3 Значения K_i в % для кратности ошибок													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
МКТ-1	4 Расширенный код Хемминга (12,7)	0	0	0	7	0	5	0	8	0	0	0	–	–	–
–	5 Корреляционный код (14,7) . . .	0	7	0	2	0	1	0	1	0	2	0	7	0	–
„Стимул-2"	5 Корреляционный код (18,9) . . .	0	6	0	1	0	0,5	0	0,7	0	0,7	0	0,5	0	1
МКТ-2	6 Смежный класс группового кода (14,8)	0	0	0	4,5	0	2,4	0	3	0	2,4	0	8	0	–

Table 2. KEY: 1) Unit of telemechanics; 2) Applied code; 3) Value of in % for multiplicity of errors; 4) Hamming expansion code; 5) Correlation code; 6) Adjacent set of group code

Table 3.

1 Скорость передачи цифровой информации в бодах	2 Продолжительность передачи сообщений ТИ и ТС в с не более для модемов		
	A0, A1, A2, A3	B0, B1, B2, B3	B0, B1, B2, B3
40	4,2	7,7	11,2
80	2,1	3,85	5,6
100	1,05	1,98	2,8

Table 3. KEY: 1) Rate of transmission of digital information in bauds; 2) Duration of transmission of reports of TI and TS in seconds no greater for models

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